INFOSHEET # 1

Ontario

Greenhouse Gases and Ontario Agriculture

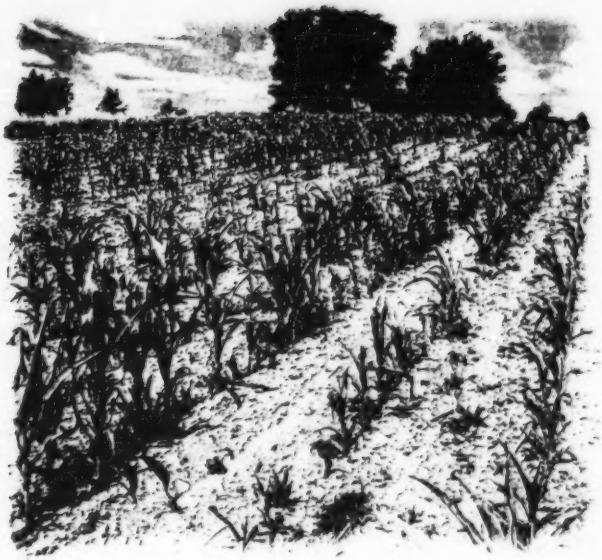
There's more talk than usual about the weather these days. Extreme weather events – flash floods, heat waves, hurricanes, melting glaciers – and their human and environmental fallout, capture headlines worldwide.

Closer to home, many of Ontario's rural communities have experienced changing weather patterns first-hand, including drought-stressed crops, flooded fields, and a devastating ice storm.

In the 20th century, scientists began documenting a gradual but steady increase in the Earth's temperature. Now a growing body of evidence is pointing toward greenhouse gases as prime contributors to global warming and climate change.

Agricultural activities are, among many other human endeavours, a source of greenhouse gases. But while some farming practices contribute to the problem, the good news is that they can be modified to become part of the solution.

All of the on-farm measures that reduce greenhouse gas emissions are also **best management practices:** affordable options that protect soil and water resources and (where relevant) maintain or increase yields.



Droughts will be more common with global warming.

This is the first of a four-part series that addresses greenhouse gas emissions and their implications for Ontario's farmers. Infosheet #1 lays out some basic concepts, including climate change, sources of greenhouse gases, which farming practices contribute to emissions, and how practices can be adjusted to reduce emissions.

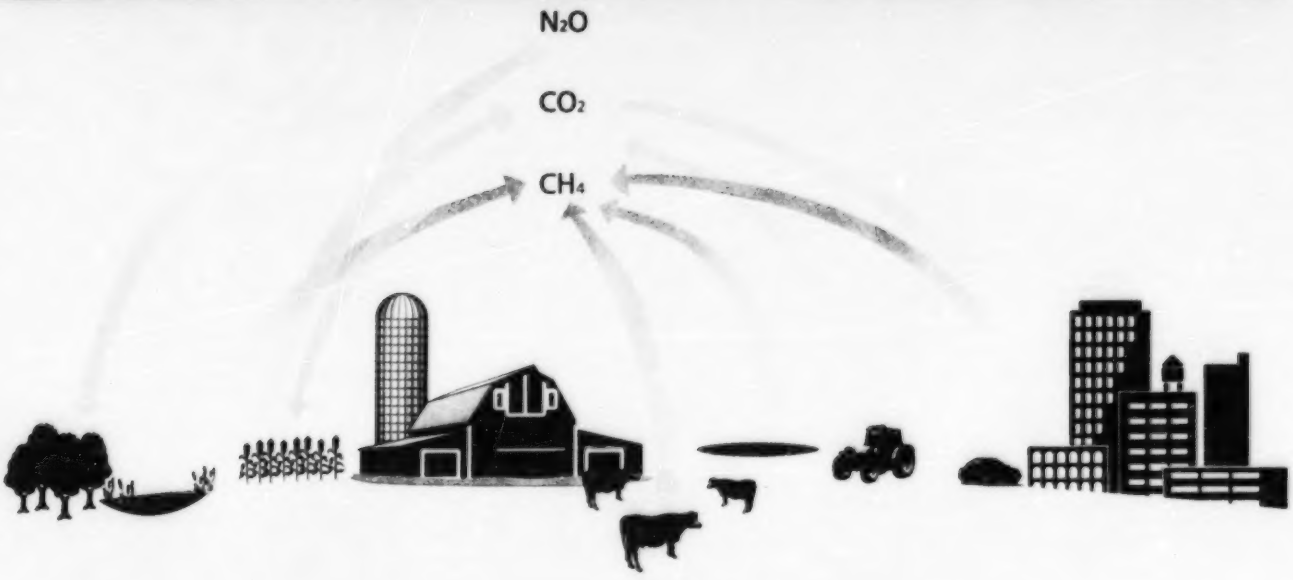
Infosheets #2, #3 and #4 will delve into greater detail, covering:

2. **carbon sequestration**
3. **nutrient management**
4. **on-farm case studies.**

All four infosheets will be available by spring 2001 at select locations, and accessible through the Ontario Ministry of Agriculture, Food and Rural Affairs web site at:
www.gov.on.ca/OMAFRA/english/policy/Climate%20Change/Index.html

Earth's average temperature could rise between 1.4 and 5.8°C over the next 100 years, according to a January 2001 report of the Intergovernmental Panel on Climate Change. The report identified an increase in greenhouse gases as the main cause of observed warming over the last 50 years.

Greenhouse Gases



Greenhouse gases (GHGs) are atmospheric gases that reflect heat energy released by the Earth back to the surface. Without this natural greenhouse effect that "holds" some of the heat in the Earth's atmosphere, the average temperature on Earth would be too cold for life as we know it.

GHGs – water vapour, ozone, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) – are necessary for life on Earth. However, excessive increases in GHG levels can cause an imbalance and lead to a warming of the Earth's surface. Some industrial, transportation, residential and agricultural activities accelerate the production of the three main GHGs (CO_2, CH_4 and N_2O), and therefore increase the risk of upsetting the atmospheric balance of GHGs.

GREENHOUSE GAS	SOURCES*	GLOBAL WARMING POTENTIAL	CHANGES IN ATMOSPHERIC LEVELS – OBSERVED OR EXPECTED
CARBON DIOXIDE (CO_2)	*Natural* • natural ecosystems • plants and animals *Other* • combustion of fossil fuels • manufacturing • tillage	1:1 (CO_2 equivalent)	• 30% increase since 1850 • 0.5% annual increase expected • 115% increase expected in this century
METHANE (CH_4)	*Natural* • wetlands and poorly drained soils *Other* • landfill sites • feed digestion by ruminants • manure storages • coal and natural gas production	21:1	• over 115% increase since 1850 • 0.75% annual increase expected in this century
NITROUS OXIDE (N_2O)	*Natural* • soils in natural ecosystems *Other* • combustion of fossil fuels • denitrification of organic and commercial fertilizers (including direct losses to air) • nitric acid and adipic acid production • manure	310:1	• 8% increase since 1850 • 0.25% annual increase expected

* Sources are not necessarily listed in order of importance

The Impact of Climate Change

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Changing weather patterns have significant implications for ecosystems, human health and safety, and for agriculture.

Ecosystems

- **shifts in vegetation or ecological zones** – it's estimated that for each 1°C increase in mean annual temperature, the vegetation zones may move pole-ward by 200 to 300 km

Shifts in natural habitat may prove deadly to some wildlife. Species such as the spotted turtle that don't adapt quickly could risk extinction.

- **changes in the water cycle** – water availability and quality will be adversely affected

Great Lakes water levels are expected to decline – and with them, surface and ground water levels, shipping activity, and hydroelectric capacity.

Human health and safety

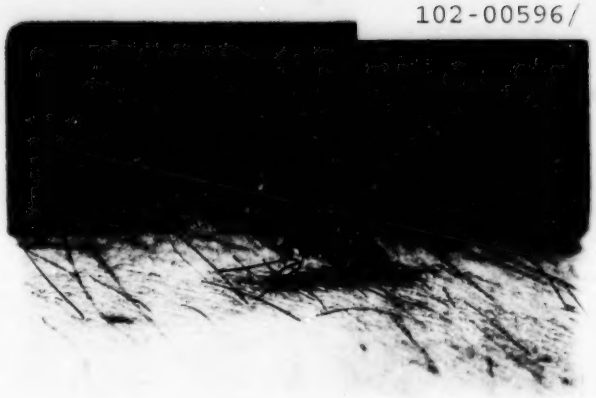
- **heat-related health concerns** – hot weather-related health problems, such as heat stress, poor air-quality days, climate-induced respiratory problems, allergies and asthma, will likely rise

- **disease concerns** – warmer temperatures and shorter cold seasons could allow disease-carrying hosts to survive at locations further north than at present

Agriculture

- **crop and livestock management decisions** – seeding dates, crop variety choices, pest and disease management, irrigation, drainage and other important factors will be affected by climate change as the agricultural season lengthens

- **crop and livestock health** – crops could be threatened by extreme climatic events and, along with livestock, by northward expansion of certain infectious agents



Incidences of diseases such as Rocky Mountain spotted fever, Lyme disease, mosquito-borne malaria, encephalitis and the West Nile virus could become more frequent and widespread in Ontario.

Agricultural Contributions to GHGs and Climate Change

Farming activities that lead to GHG emissions include:

- soil cultivation – allows carbon to be converted to CO_2
- applications of fertilizers and manures – N_2O loss to atmosphere
- ruminant and other livestock operations – CH_4 production
- woodlot clearing – stored carbon in vegetation is released as CO_2.

"From the agriculturist's perspective, the measures needed to control GHG emissions are most efficiently directed towards reductions in N_2O since it has a 310-fold greater impact than CO_2. Fortunately, the practices which reduce N_2O emissions will lead to enhanced efficiency in nitrogen use and an increased proportion being incorporated into biomass – a win-win situation for slowing the increase in the Earth's temperature."

– **Dr. K.B. MacDonald**, soil scientist, formerly with Agriculture and Agri-Food Canada

AGRICULTURAL CONTRIBUTIONS TO GREENHOUSE GAS PRODUCTION

GREENHOUSE GAS	AGRICULTURAL SOURCE	CAUSES
CARBON DIOXIDE (CO_2)	• soils	• tillage practices • clearing woodlots and soil drainage
	• fossil fuel combustion	• running machinery • heating farm buildings
METHANE (CH_4)	• ruminant livestock • manure • soils	• digestion of feeds by cattle, sheep, goats and deer • decomposition of manure during storage and application • bacteria produced by poorly drained soils
NITROUS OXIDES N_2O	• manure storage	• natural production of (N_2O) during storage • immediate loss to atmosphere ("volatilization") during fertilizer application
	• soil denitrification – conversion of plant-available nitrogen (N) to gases	• use of excess fertilizers, particularly in seasons when plants cannot uptake the N (late fall, winter, early spring) • no or delayed incorporation, or commercial storage

Challenges for Ontario agriculture

The province's agriculture sector has four key challenges when it comes to GHG reduction.

1. It will be difficult to manage GHG generation as production of crops and livestock increases.
2. With low commodity prices, it will be difficult for producers to afford the necessary technological changes.
3. Agricultural research and technology-transfer agencies need to develop suitable GHG technologies to reduce emissions.
4. Technologies will require costly monitoring and modeling to verify that they work.

GHGs are extremely long-lasting, and any remedial measures will take some time to slow down the increase in GHG emissions. The life spans of CO_2 and other GHGs are such that, even if emissions were reduced to and then maintained at the 1995 level, the CO_2 atmospheric levels would still increase at an almost constant rate for another 200 years.

A lowering to 1995 levels would require immediate, substantial – and in some cases very difficult – technological, economic and social actions.

What is carbon sequestration?

Depending on how it's managed, farmland can be either a source of GHGs (emitting CO_2) or a sink (storing CO_2). Carbon fixing or sequestration is the capture and removal of CO_2 gas from the atmosphere. This is done through photosynthesis and subsequent storage in solid organic material in plants and soil. For much more information on management techniques that promote carbon sequestration, see Infosheet #2 in this series.

Crops

Farmers can reduce input costs and GHG emissions by adopting best management practices for nutrients. Managing nutrients – especially nitrogen – with BMPs involves:

- soil and manure testing
- maximizing nutrient availability during key growth periods
- reducing the amount of excess N available during peak loss periods in spring
- eliminating or reducing fall or winter application, and
- minimizing tillage.

Livestock & Manure Management

By modifying livestock rations, livestock producers can reduce CH_4. Methane is a GHG that's released as a by-product of ruminant digestion.

Proper manure storage and handling methods can retain nutrients for crops and reduce GHG emissions.

OPPORTUNITIES FOR ONTARIO AGRICULTURE

BEST MANAGEMENT PRACTICES FOR GREENHOUSE GAS REDUCTION

BEST MANAGEMENT PRACTICE	WHAT'S INVOLVED	GHG BENEFITS
NUTRIENT MANAGEMENT		
Nitrogen management	• use pre-sidedress N test • optimize N availability at key times of crop need and uptake ability • test manure • increase spring application, avoid fall/winter application • credit N from other sources (e.g., cover crops, previous crops, legumes, manure) • incorporate pre-plant applications within 1 day	• minimizes residual soil N • reduces N inputs • limits excess soil N, especially during spring and winter thaw when plant uptake does not occur • reduces indirect N loss and atmospheric loss • avoids over-application of N and excess soil N • reduces direct N_2O loss
Livestock management	• modify livestock rations to reduce dry matter	• reduces CH_4, which is released as by-product of digestion
SOIL MANAGEMENT		
Buffer strips	• establish buffers or enhance existing buffers with trees, shrubs and ground cover along field borders and streambanks	• reduces indirect N losses (removes excess N from soil reduces leaching) • intercepts surface and ground water flow containing N compounds • fixes carbon
Retirement of marginal land	• plant marginal and fragile lands to permanent cover	• removes soil from intensive cultivation • eliminates nutrient inputs to land • allows buildup of soil organic matter • fixes carbon in the perennial vegetation before it reaches watercourses • allows uptake of nutrients in buffer vegetation
Cover crops and crop rotations	• maintain live cover crops over winter following "high-use" N crops • use crops with high N requirements after forages (e.g., corn), high N-producing crops or residues	• minimizes residual N • reduces fertilizer requirements by accounting for previous crop N contributions
No-till and conservation tillage	• practise no-till – leave residue on field surface until spring	• increases soil organic matter • reduces CO_2 loss • sequesters carbon
MANURE MANAGEMENT	• eliminate or minimize winter spreading of manure	• reduces amount of excess N available during spring when potential N_2O losses are greatest
AGROFORESTRY • Windbreaks (<5 trees wide) • Shelterbelts (5 or more trees wide) • Riparian buffers (in streambank and floodplain areas)	• increase number, length, width and tree species diversity • practise good forest management and harvest selectively	• sequesters carbon • requires no fertilization • reduces indirect N losses • can offset long-term sequestration costs (e.g., tree planting, removal of land from cultivation)

Emissions trading – a potential win-win for farmers and industry

Farmers who practise good management of soil and water resources realize the benefits of improved productivity, lower input costs, and the pride in being a steward of the land for present and future generations.

However, adapting current practices to reduce GHG emissions and other impacts on the environment doesn't come without a cost.

Carbon or emissions trading is an evolving short-term option that may help farmers offset these costs. Carbon credits (or carbon dioxide equivalents) may become a commodity for trade.

GHG-producing industries may soon be willing to pay farmers to adopt GHG-friendly best management practices that will reduce emissions (e.g., improving nutrient management) and sequester carbon (e.g., practising no-till and planting trees).

The carbon or emissions trading system would in effect "buy time" for industry to make the necessary technological changes that will reduce GHG emissions. It is a solution that would help industry meet targets in the near term.

Agroforestry

The introduction and/or enhancement of riparian and other forests will help sequester carbon and reduce indirect N losses. These practices can also reduce costs associated with flooding and subsequent drainage channel reconstruction.

"Agriculture has a unique role to play in Canada's commitment to reduce GHGs, having the ability to both reduce GHG emissions as well as sequester carbon. The implementation of best management practices will be a win-win situation for agriculture. BMPs are not only good for the environment, but are also designed to be economically friendly to the producer."
– Steve Broad, Soil Conservation Council of Canada director and member of Innovative Farmers Association of Ontario

"With our herd of 190 beef cows, we have tried to maximize production with better pasture management...a rotational grazing system. This is just another example of multiple benefits – less erosion on our rolling farm, improved gains per acre, and increased organic matter/carbon in the soil."
– Bob Dobson, Cobden producer and member, Ontario Cattlemen's Association

Where to go for more information

Key web sites

Your link to OMAFRA's Climate Change resources
http://www.gov.on.ca/OMAFRA/english/policy/Climate%20Change/Index.html

Web site for National Climate Change Process. Available documents include: "Canada's First National Climate Change Business Plan," and "Ontario – Air Quality and Climate Change: Insights, Opportunities and Solutions"
http://www.nccp.ca

Multimedia overviews of climate change, and links to GHG calculators
http://www.climatechange.gc.ca

For farmers and rural land owners

The Best Management Practices series of books, including: *Farm Forestry and Habitat Management, Field Crop Production, No-till: Making it Work, Nutrient Management* and *Soil Management* – available by calling 1-888-4-OMAFRA (1-888-466-2372) or e-mail your request to **products@omafra.gov.on.ca** or visit OMAFRA's web site at www.gov.on.ca/omafra

Technical reports

McMichael, J. et al, eds. "Climate Change and Human Health," World Health Organization, Geneva: 1996

Watson, Robert T., et al, eds. "The Regional Impacts of Climate Change – An Assessment of Vulnerability," IPPC, Geneva: 2001

Soil Resource Group. "Ministry Management Practices and Their Effect on GHG Emissions in the Ontario Agricultural Sector." Final report to the Ontario Ministry of Agriculture, Food and Rural Affairs, 2000

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The Greenhouse Gas infosheets are a project of the Ministry of Agriculture, Food and Rural Affairs.

For more information, call the Ministry of Agriculture, Food and Rural Affairs, Agricultural Information Contact Centre at 1-877-424-1300, or e-mail: ag.info@omafra.gov.on.ca

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